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Management of Neglected Post Burn Knee Flexion Contracture Using Spatial Ilizarov Frame: A Case Series

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Abstract

Post-burn flexion contractures of the knee can lead to significant morbidity, affecting both the function and appearance of the affected limb. This study aims to evaluate the effectiveness of the spatial Ilizarov fixator system in managing severe knee contractures following burn injuries. By combining Ilizarov frame construct with the distal hamstring release, we sought to improve both functional outcomes and cosmetic appearance, thus enhancing the overall quality of life for patients.

Materials and Methods: This prospective study included 18 patients who sustained burn injuries resulting in severe knee flexion contractures. A two-pronged approach was used, consisting of soft tissue release and the application of the spatial Ilizarov fixator system, with two uniplanar posterior hinge distractors. Distraction was performed at a rate of 1mm per day, accompanied by continuous neurovascular monitoring throughout the process. The duration of treatment varied from two to three months, with the follow-up period for 1-2 years.

Results: All patients showed significant improvements, with near-complete correction of the knee deformity. The majority of patients were able to achieve a

functional bipedal gait post-treatment. While a few complications arose during the course of the treatment, these were managed appropriately and did not compromise the overall success of the intervention.

Conclusion: The combination of gradual deformity correction using the Ilizarov fixator and soft tissue release offers excellent outcomes in the treatment of post-burn knee flexion contractures. This approach significantly enhances functional mobility and provides cosmetic benefits, thereby improving the overall lifestyle and well-being of patients. The study demonstrates that the spatial Ilizarov system is an effective and reliable method for managing these challenging deformities.

Keywords: Post-burn flexion, cosmetic appearance, cerebral palsy, surgical treatment

Introduction

A flexion contracture of the knee is the condition in which the knee is in a fixed bent position and unable to achieve full extension. The etiology of the flexion contracture can be multifactorial, related to previous trauma, burn injuries, cerebral palsy, polio and advanced osteoarthritis or inflammatory arthritis [1]. We conducted a study among the patients of post burn knee contractures. Burn contractures produce restrictions in motion and unacceptable aesthetic results, frequently with persistent wounds. Post burn flexion contractures of the knee, making up 22% of large joint contractures, presents as cosmetic defects, severely affecting lifestyle of the patient, requires surgical treatment [2]. This study was carried out to assess the results of gradual correction of post burn flexion contracture of the knee joint using ring fixator system.

Materials and methods

Eighteen patients with post burn knee scar contractures were studied and operated by us using ring fixator system achieving gradual distraction. The study was approved by the local ethical committee and all the patients were consented and explained in detail regarding the procedure.

Among them, ten were adult males, seven were adult females and one was an adolescent female. They were of around one to three-year duration of post burn status. All the patients suffered deep partial and full thickness burns of lower limb from 11 to 25 % of the total body surface area resulting in knee flexion contracture formation. All the patients in our study belongs to grade 3 flexion contracture. After thorough study and evaluation, operative intervention with ring fixator system was performed.

The procedure involves release of hamstrings and constricted fibrotic bands, followed by construction of ring frame with distractors. The frame consisted of a femoral block and a tibial block connected together using two uniplanar posterior hinges (posterior to the centre of rotation of the knee joint), one medial and one lateral. Posterior distraction mechanism was used to gradually correct the deformity. Distraction was started as soon as the postoperative pain subsided at an average of 2 full turns/day to produce a distraction rate of 1 mm/day at the posterior aspect of the knee joint.

After every 3 weeks of distraction, resting period of ten days were given to prevent overstretching of the neurovascular bundle. The duration of correction ranged from 6 to 10 weeks (mean: 8±1.3 weeks). All patients were kept in the frame for 4 weeks after achieving full correction. Then, the frames were removed and above-the-knee plaster cast was applied for 4 weeks. Then, a brace was used to guard against recurrence for 3 months following removal of the cast.

Results

Desirable correction to almost full extent achieved in all the patients. Post removal of the ring fixator, achieved correction was maintained in the above knee cast for 4 to 6 weeks. The follow-up period ranged from 12 to 30 months (mean: 24±4 months) following removal of the brace. One patient developed ipsilateral ankle equinus deformity along with sensory disturbance over the dorsum of foot following the procedure. Sensory function fully improved with conservative management, while operative intervention was performed to overcome fixed equinus deformity. Immediately after frame removal, all had the problem of knee stiffness, which gradually improved with rehabilitation.

Fourteen patients had no recurrence of the deformity after a year follow up, whereas four patients had partial recurrence of the deformity of around 15 degrees flexion contracture. All the patients were able to walk without any walking aids. Patients who developed recurrent flexion deformity of 15 degrees were given a high heel for compensation.

None of the patients included in this study had fractures during frame application or during the period of follow-up. In addition, none of them had vascular injuries during frame application or during distraction.

Discussion

Burn injury is still the common cause of trauma especially in low- and middle-income countries [3]. Burn contractures produce restrictions in motion and unacceptable aesthetic results, frequently with persistent wounds. Post burn flexion contractures of the knee, making up 22% of large joint contractures, presents as cosmetic defects, severely affecting lifestyle of the patient, requires surgical treatment [2]. Neglected burn wound undergo severe tension and tearing, often are converted to pathologic scars-rough, thick, solid, prone to keloid growth and ulceration. Patients with severe deformity or long-standing deformity may not be manageable by routine procedures [4] like Z plasty / STSG / Flaps [5] due to involvement of joint (subluxation), shortening of intra articular cruciate ligaments, articular ligaments and capsule.

Non-fatal burn injuries are a leading cause of morbidity. Burns occur mainly in the home and workplace. Burn scar contractures are severely disfiguring, painful, and itching. Extensive burns result in the formation of severe contractures. Patients with burn scar contractures feels interference with activities of daily living and experience difficulties in receiving education and securing work [6].

Two types of flexion contracture of the knee can be distinguished: the one associated with joint destruction and fibrous ankylosis (type I), and the other in which joint anatomy, and mobility are preserved (type II). Type I deformities are even more challenging to treat. Flexion contracture of the knee is the cause of crouch gait pattern, instability in stance phase of gait, and difficulties during standing and sitting, and for daily living activities It may also cause patella alta, degeneration of the patellofemoral joint, and stress fractures of the patella and tibial tubercle in young adults. Severe knee flexion contractures greater than 80 are rare and challenging to manage. Previous studies have demonstrated unsatisfactory clinical results after correcting these deformities because residual flexion contractures were not corrected within a short period of time. Such patients frequently have cutaneous and vascular complications as well as recurrence of the contracture after treatment.

Current methods of managing contractures are soft tissue release, external fixator and rail fixator. Many surgical

procedures have been proposed to treat fixed knee flexion deformities including casting [7], posterior soft tissue release [8,9], osteotomies [10], and femoral shortening [11,12]. We present a strategy consisting of gradual correction of the deformity through distal hamstring releases and application of femorotibial external fixator, when extension of the knee is limited by excessive posterior soft tissue tension. Several advantages offered by ring external fixator are progressive correction of complex knee deformities with simultaneous correction of associated foot deformities/ limb length discrepancies/ neurovascular shortening [13].

Acute correction of knee flexion contracture with soft tissue release, osteotomy, or both may lead to serious complications. In contrast, gradual correction of knee flexion contracture, a circular frame and a constrained hinge, avoids acute stretch injury to soft tissue and prevents compression of the anterior joint. Furthermore, gradual correction with histogenesis leads to soft tissue lengthening which should make the contracture less likely to recur.

Treatment of the more severe deformities is associated with serious complications such as insufficient correction, skin necrosis, neurovascular problems, leg-length discrepancy, posterior subluxation, and recurrence of the deformity [14]. The Ring fixator technique allows for gradual correction of the most complex deformities of the knee. In this method, the rate of correction can be modified according to the severity of the deformity, and degree of contracture. Gradual distraction of the soft tissues by the Ring fixator technique prevents the hazards of rapid extension of the chronically contracted and flexed knee joint that can result in ischemia, gangrene, and amputation [15].

Treatment of severe type I deformity using osteotomy or arthrodesis requires excision of a significant amount of bone to be able to `correct the deformity without skin and neurovascular compromise. This will lead to significant limb-length discrepancy in unilateral cases. Guided growth is not an option in adults and might not be suitable in severe cases. In addition, it will result in significant limb-length discrepancy in unilateral cases. Soft tissue procedures might not be effective in cases with knee joint destruction and ankylosis (type I deformity). Therefore, gradual distraction through Ring fixator system might be the most accepted method of treatment in such cases.

Damsin and Ghanem [14] used Ilizarov frames to treat 13 knees with fixed flexion deformities. The age of their patients ranged from 1.7 to 18.8 years. They had fractures in four patients, common peroneal nerve palsy in one patient, and recurrence of the deformity in four patients. The fractures occurred in children with congenital webbing treated at the ages of 1.7 and 4.8 years of age. The fractures occurred during the correction of posterior subluxation of the tibia and were considered to be owing to shearing forces. They considered flexion deformity of the knee secondary to congenital webbing as the most difficult type to treat [14].

El Gafary [15] used Ilizarov frames to correct flexion deformities in 20 knees of 12 patients. All patients were affected by anterior poliomyelitis. Their mean age was 13.5 years. The mean deformity was 55° (35–100°). He achieved almost full correction without any skin or neurovascular complications. He had two posterior subluxations that were corrected during treatment [15].

Hosny and Fadel [16] treated 50 patients with 29 unilateral, and 21 bilateral knee flexion deformities

using Ilizarov frames. The mean angle of maximum extension to maximum flexion improved from a preoperative average of 68° (25–140°), to an average of 3.5° (0–20°) after removal of the fixator. At the last follow-up, the average angle was 13.5° (0–70°). They reported fractures in seven patients and knee subluxation in three cases. They concluded that a circular frame is an effective method that also allows a possibility to correct other deformities, to reduce the joint, and to lengthen the bone concomitantly. In addition, they believe that recurrence of the deformity appears to depend on the etiology and not the type of treatment and that the relatively high rate of recurrence is still unsolved [16]. Gaurav [17] used Ilizarov frame to treat 39 knees in 26 patients with fixed flexion deformities. All of his patients achieved complete correction without significant complications [17].

This study included 18 patients with severe flexion deformity of one of their knees together with knee joint destruction and loss of movements. All the patients belong to grade 3 flexion contracture of the knee. Our technique achieved almost full correction of the flexion deformity in all the cases despite the fact that all knees showed marked destruction and intra-articular adhesions, before frame application. One patient developed ipsilateral equinus deformity probably due to the severity of the contracture which was well treated by surgical intervention. The patients who developed partial recurrence of the deformity managing their daily life activities using shoe modification (heel raise). None of our patients had fractures or vascular injuries during frame application and during the period of distraction.

Conclusion

Through this study we found that in post burn knee flexion contracture cases, procedure of distal hamstring release with gradual deformity correction using ring fixator system gives best results as almost all the patients achieved bipedal stable gait without support and able to perform their daily routine activities comparable with normal individuals. However, the recurrence after frame removal remains a problem which can be prevented by strong compliance of the patient with braces and regular follow up. We strongly suggest this technique as it greatly helps in reducing the morbidity of post burn contracture patients.

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Legend Figures:

Figure 1: Pre op image

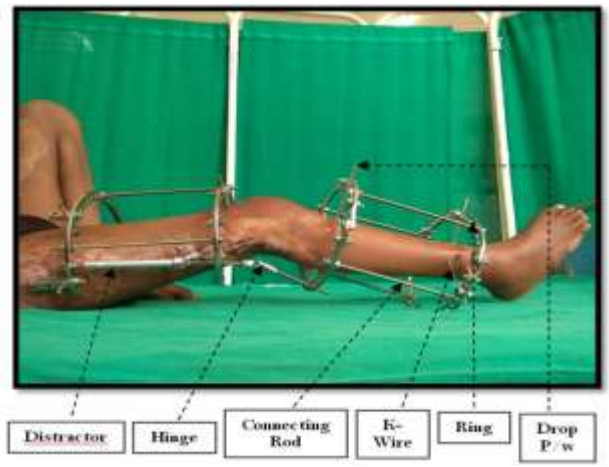

Figure 2: Post correction image

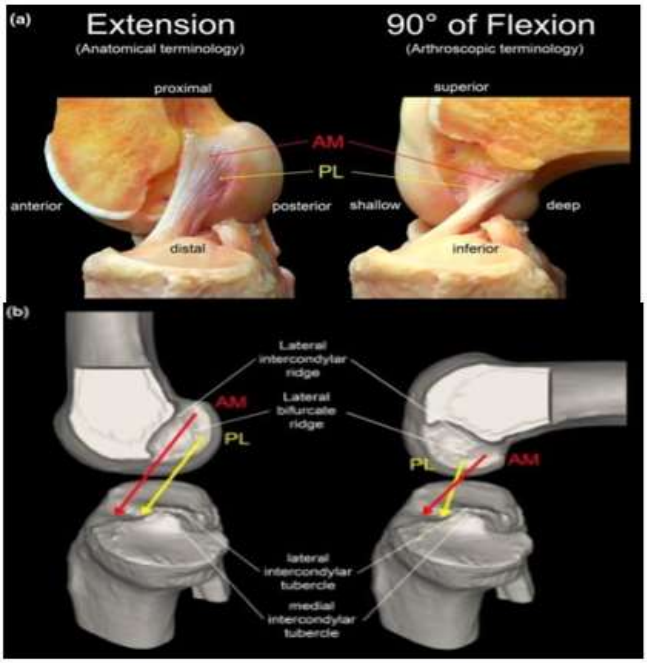

Figure 3:

Figure 4:

Figure 5: